MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 2, 2019/2020

DMT5131 – MATHEMATICAL TECHNIQUES 1

(For DIT students only)

4 MARCH 2020
9.00 a.m. – 11.00 a.m.
(2 Hours)

INSTRUCTIONS TO STUDENT

1. This question paper consists of **2** pages with **3** questions excluding the cover page and Appendix. Key formulae are given in the Appendix.
2. Answer **ALL** questions.
3. Write your answers in the answer booklet provided.
4. All necessary working steps must be shown.

Question 1

a. Show that the solution of the following equation is $x = -\frac{3}{10}$. (2.5 marks)

$$\frac{x}{2} = \frac{4x}{3} + \frac{1}{4}$$

b. Solve the inequality, $\frac{5x-2}{6-3x} \geq 0$. (2.5 marks)

c. Given a quadratic function, $f(x) = 9x^2 - 15x + k$, where k is a constant value.

i. If discriminant of $f(x)$ is 729, find the value of k. [Hint: Discriminant $= b^2 - 4ac$] (2 marks)

ii. Find the axis of symmetry. (1 mark)

iii. Find the x-intercept of $f(x)$. (2 marks)

[TOTAL 10 MARKS]

Question 2

a. Given that matrix $E = \begin{bmatrix} 4 & 0 \\ 7 & -3 \\ -5 & 6 \end{bmatrix}$, matrix $F = \begin{bmatrix} 3 & -4 \\ 2 & 1 \end{bmatrix}$ and matrix $G = \begin{bmatrix} 2 & 1 & 0 \\ 3 & 0 & 1 \end{bmatrix}$. Find $GE - F^T$. (4 marks)

b. To do laundry by using washing machine, it involved 3 processes: washing, rinsing and spinning. The following table records the duration used by 3 persons in these 3 processes.

	Washing (kg)	Rinsing (kg)	Spinning (kg)	Total duration (Minutes)
Ali	3	1	1	82
Bakar	4	2	2	134
Chong	5	3	2	179

i. Represent the above information in a system of linear equations. Let x, y and z represent the duration needed to wash, rinse and spin respectively for 1kg of clothes. Assume the duration for every process (washing, rinsing and spinning) is linearly affected by the mass of laundry. (1.5 marks)

ii. By using Cramer's rule, find the values of x, y and z. (9.5 marks)

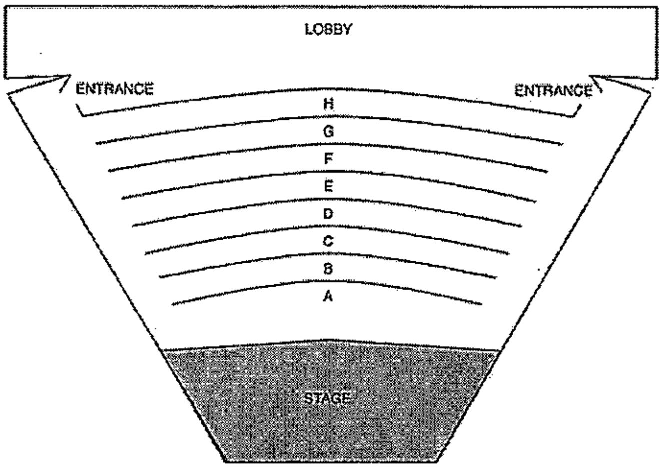
[TOTAL 15 MARKS]

Continued…….

Question 3

a. Find the sum of the sequence $\sum_{u=2}^{4} \frac{2u!}{u-1}$. (2 marks)

b. The auditorium seating layout is shown in figure below. Row A consists of 20 chairs and every subsequent row will have additional 3 chairs added to them.



i. How many chairs in Row F? (2 marks)

ii. Which row consists of 26 chairs? (3 marks)

iii. If this auditorium seating layout goes from Row A to Row H, how many chairs are there in total? (2 marks)

c. Given a geometric series, $1.1 + 0.33 + 0.099 + \ldots$. Find the sum of the infinite geometric series in fraction form. (3 marks)

d. Find the 7[th] terms of the expansion $(2x + y^2)^{10}$. (3 marks)

[TOTAL 15 MARKS]

End of Page

Appendix

Inequalities:

$\|u\| < a \quad \Rightarrow \quad -a < u < a$	$\|u\| > a \quad \Rightarrow \quad u < -a \quad or \quad u > a$
$\|u\| \le a \quad \Rightarrow \quad -a \le u \le a$	$\|u\| \ge a \quad \Rightarrow \quad u \le -a \quad or \quad u \ge a$

Completing the square:

$$x^2 + bx + \left(\frac{b}{2}\right)^2 = \left(x + \frac{b}{2}\right)^2$$

Quadratic formula:

If $ax^2 + bx + c = 0$ where $a \neq 0$, then $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Standard form of a quadratic function:

$f(x) = a(x-h)^2 + k,\ a \neq 0$

Determinant of a 2 × 2 matrix	***Determinant of a 3 × 3 matrix***
$\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} = a_1b_2 - a_2b_1$	$\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix} = a_1\begin{vmatrix} b_2 & c_2 \\ b_3 & c_3 \end{vmatrix} - b_1\begin{vmatrix} a_2 & c_2 \\ a_3 & c_3 \end{vmatrix} + c_1\begin{vmatrix} a_2 & b_2 \\ a_3 & b_3 \end{vmatrix}$
Inverse of a 2 × 2 matrix	***Inverse of a 3 × 3 matrix***
If $A = \begin{bmatrix} a & b \\ c & d \end{bmatrix}$ then $A^{-1} = \dfrac{1}{ad-bc}\begin{bmatrix} d & -b \\ -c & a \end{bmatrix}$ where $ad - bc \neq 0$.	$A^{-1} = \dfrac{1}{\|A\|}\left[c_{ij}\right]^T$ $A^{-1} = \dfrac{1}{\|A\|}\begin{bmatrix} c_{11} & c_{21} & c_{31} \\ c_{12} & c_{22} & c_{32} \\ c_{13} & c_{23} & c_{33} \end{bmatrix}$ $A^{-1} = \dfrac{1}{\|A\|} adj\, A$ where $\left[c_{ij}\right]^T$ is called the adjoint of A (adj A). c_{ij} of the entry $a_{ij} = (-1)^{i+j} M_{ij}$

Cramer's Rule for 2 × 2 matrix	***Cramer's Rule for 3 × 3 matrix***
If $\begin{array}{l} a_1x+b_1y=c_1 \\ a_2x+b_2y=c_2 \end{array}$ then $x=\dfrac{\begin{vmatrix} c_1 & b_1 \\ c_2 & b_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$ and $y=\dfrac{\begin{vmatrix} a_1 & c_1 \\ a_2 & c_2 \end{vmatrix}}{\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix}}$ where $\begin{vmatrix} a_1 & b_1 \\ a_2 & b_2 \end{vmatrix} \neq 0$	If $\begin{array}{l} a_1x+b_1y+c_1z=d_1 \\ a_2x+b_2y+c_2z=d_2 \\ a_3x+b_3y+c_3z=d_3 \end{array}$ then $x=\dfrac{D_x}{D}, y=\dfrac{D_y}{D}, z=\dfrac{D_z}{D}$ where $D=\begin{vmatrix} a_1 & b_1 & c_1 \\ a_2 & b_2 & c_2 \\ a_3 & b_3 & c_3 \end{vmatrix}, D_x=\begin{vmatrix} d_1 & b_1 & c_1 \\ d_2 & b_2 & c_2 \\ d_3 & b_3 & c_3 \end{vmatrix},$ $D_y=\begin{vmatrix} a_1 & d_1 & c_1 \\ a_2 & d_2 & c_2 \\ a_3 & d_3 & c_3 \end{vmatrix}, D_z=\begin{vmatrix} a_1 & b_1 & d_1 \\ a_2 & b_2 & d_2 \\ a_3 & b_3 & d_3 \end{vmatrix}$

Arithmetic sequence	***Geometric sequence***
$a_n=a_1+(n-1)d$ $S_n=\dfrac{n}{2}(a_1+a_n)$	$a_n=a_1r^{n-1}, S_n=\dfrac{a_1(1-r^n)}{1-r}$ $S_\infty=\dfrac{a_1}{1-r}, \lvert r\rvert<1$

Binomial Theorem

$$(a+b)^n=\sum_{k=0}^{n}\binom{n}{k}a^{n-k}b^k; \quad n\geq 1$$

The $(r+1)^{\text{st}}$ term in the expansion of $(a+b)^n$ is $\dbinom{n}{r}a^{n-r}b^r$.